



ISO 9001
ISO 14001
BS OHSAS 18001
HSE-MS

www.borna-co.com

@bornaelectronics

bornaelectronic

bornaelectronics

info@borna-co.com

Plan & Design - Installation

CATHODIC PROTECTION SYSTEMS

- Design
- Engineering Services
- Procurement
- Construction
- Commissioning
- Supervision

Corrosion
Under
Control



2020 | www.borna-co.com



■ You Can Control Corrosion ■



■ Smart Explosion Proof Transformer Rectifier ■



Design Engineering Services Procurement Construction & Commissioning Supervision of Cathodic Protection Systems



BORNA Electronics Co. is one of the leading EPC cathodic protection contractors based in Tehran-Iran. Our company was established in 1984 and now, consists of three factories working with 100% production capacity, having over 80 engineers and over 150 skilled workers. More over our well educated engineers are active in several mega-projects in parallel in all around Iran, especially in South Pars Gas Fields.

BORNA Electronics Co. board of engineers can provide best solutions for all aspects of corrosion-related problems in the field of cathodic protection such as modification of already built systems and provide optimum solution for customer facilities in such a way that maximum energy preservation an minimum cost are achieved.

BORNA Electronics Co. has the certificate of contractor qualification with grade. 2 in utility and equipment, it also has grade. 5 in oil, gas, power and energy.

Our major clients include followings:

- ❑ **Ministry of Petroleum**
 - ♦ National Iranian Oil Company (NIOC)
 - ♦ National Iranian Gas Company (NIGC)
 - ♦ National Iranian Oil Products Distribution Company (NIOPDC)
- ♦ National Petrochemical Company (NPC)
- ♦ Pars Oil and Gas Company (POGC)
- ❑ **Ministry of Industry, Mine and Trade**
- ❑ **Ministry of Energy**
- ❑ **Ministry of Roads and Urban Development**

We have the experience and capability of undertaking major turnkey contracts in a huge variety of locations and conditions. Our major areas of expertise include followings:

- ❑ **Onshore Cathodic Protection Systems**
(Transmission Pipelines, In-Plant Pipings, Buried Drums and Vessels, Storage Tanks, etc.)
- ❑ **Offshore Cathodic Protection Systems**
(Jetties, Harbors, Jackets, Platforms, Sub-Marine Pipelines, Ships, Vessels, etc.)
- ❑ **Reinforced Concrete Cathodic Protection Systems**
(Bridges, Buildings, Jetties, Marine Structures, etc.)
- ❑ **Impressed Current Anti-Fouling Systems**
(Sea Chests, Strainers, Box Coolers, Seawater Intake Pipes, Seawater Pumps, etc.)

❖ Cathodic Protection Methods

Cathodic protection in industries for onshore, offshore, reinforced concrete structures are done in two methods include sacrificial (Galvanic) and impressed current. In sacrificial (Galvanic) systems, potential difference between two metals lead to corrosion of active metal and protect of noble metal while in the impressed current systems a transformer rectifier is used.

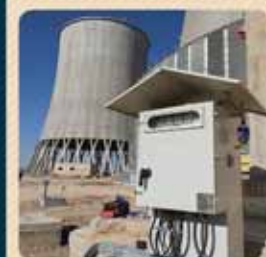
❖ Available Engineering Services

- ❑ **Site Survey**
- ❑ **Coating Inspection**
(DCVG, C-Scan, PCM/ACVG and CIPS Tests)
- ❑ **Electrolyte Analyses**
(Resistivity, pH, SRB, Chloride and Sulphate Content)
- ❑ **Stray Current Survey and AC Mitigation**
- ❑ **Design and Consulting**
- ❑ **Procurement of Equipment**
- ❑ **Construction or Supervision**
- ❑ **Commissioning and Maintenance**
- ❑ **Training**

❖ Onshore Cathodic Protection Systems

Corrosion of metal in contact with soil and water or other electrolytes is unavoidable and first solution to protect the metal surface is suitable coatings. However, coatings cannot provide a complete protection against corrosion because existence of defects and holidays and damages result of construction and operation activities. The cathodic protection systems act as a necessary supplement for coatings against corrosion. The major applications of onshore cathodic protection systems include followings:

- Transmission Pipelines (Water, Oil, Gas, etc.)
- In-Plant pipings (Refinery, Petrochemical, Power Plant, etc.)
- Buried Drums and Vessels
- Storage Tanks (Internal and External Surfaces)



❖ Offshore Cathodic Protection Systems

In marine environments due to salty and flowing water, metals especially ferrous metals undergo an accelerated corrosion. To prevent this, structures must be surveyed and monitored regularly and cathodic protection systems are necessary to avoid damages and major due expenses. The major applications of offshore cathodic protection systems include followings:

- Jetties and harbors • Jackets and platforms • Sub-marine pipelines • Ships and vessels



❖ Reinforced Concrete Cathodic Protection Systems

Following investigation carried out on this subject, corrosion of steel reinforcements in concrete is the main reason for early failure and in some cases it can cause the total destruction of concrete structures. Parameters of corrosion of steel reinforcements in concrete are as follows:

- Chloride ions attacks • Concrete carbonation

Over the past decades cathodic protection systems have been effective and reliable method for corrosion control of steel reinforcements in concrete. By applying this method to reinforcements, the life expectancy increases up to 100 years. The ability to measure corrosion rate and utilizing cathodic protection of steel reinforcements is the main reason for its reliability.

The major applications of reinforced concrete cathodic protection systems include followings:

- Atmosphere exposed reinforced concrete structures (Buildings, Bridges, etc.)
- Immersed reinforced concrete structures (Jetties, Marine Structures, etc.)
- Buried reinforced concrete structures (Building Foundations, etc.)



❖ Impressed Current Anti-Fouling Systems

The impressed current anti-fouling systems have proved to be an extremely effective and versatile system for eliminating blockages in seawater pipework caused by bio-fouling. The systems are based on the electrolytic principle and usually consists of pairs of copper and aluminum and ferrous anodes which are mounted in sea chests or strainers and wired to a control panel. In operation, the copper anode produces ions which are carried by the flow of seawater, creating an environment in which barnacles and mussels will not settle or multiply. The major applications of impressed current anti-fouling systems include followings:

- Sea chests
- Strainers
- Box coolers
- Seawater intake pipes
- Seawater pumps



Manufacturing of Cathodic Protection Equipment

1. Transformer Rectifier
2. All Type of Boxes
3. Impressed Current Anodes
4. Galvanic Anodes
5. Measurement Instruments
6. Accessory Equipments

1. Transformer Rectifier

Direct current for cathodic protection of buried or immersed structures is normally supplied from transformer rectifiers. These units provide a means of controlling and can be instrumented to give continuous indication of the status of cathodic protection system.

- **AC Input:** 1 Phase (220V-230V) or 3 Phase (380V-400V)
- **DC Output:** Any Quantities for Current & Voltage

Cooling System	(ONAN): Oil Natural Air Natural
	(AN): Air Natural
	(AF): Air Forced
	63 Steps (with Fine, Medium, Course Selectors)
Output Control Mode	Auto Transformer Type (Regavolt)
	Electronic Control (Thyristor Regulator Control)
	• Constant Current
	• Constant Voltage
	Auto Transformer/Electronic Control
	Smart (Thyristor Regulator Control)
	• Constant Current
	• Constant Voltage
	• Constant Potential
	Microprocessor Based Control (Switching)
New Technology	Explosion Proof Type
	Compact Type
	Marine Type
	Photovoltaic Type



Explosion Proof Transformer Rectifier



Explosion proof transformer rectifiers designed in compliance with hazardous location requirements to withstand an explosion that could occur within it and to prevent the explosion of flammable material - liquid or gas - which might externally surround it.



Photovoltaic Transformer Rectifier

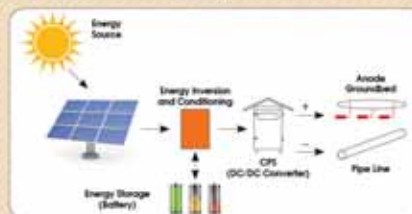
While it is not profitable to use electricity network for supplying it for cathodic protection system because of the cost of electricity transmission, solar (Photovoltaic) system can provide electricity at fair price. Photovoltaic systems convert sunlight directly into direct current (DC). The main component of these systems include:

- Solar modules
- Inverter (Convert the DC Voltage to AC or DC with Another Specification)
- Charger control (A Device to Control the Input/Output Power to Battery and Load)
- Battery storage

Because many cathodic protection stations are located in remote areas and are in the route of oil pipeline, gas, water, etc. normally supplying electricity to them are one of the main problem for the designer and executor of projects.

The advantage of photovoltaic systems:

- Avoid mortal reserves loose by country
- Prevent environmental pollution
- No need for large power transmission and distribution line of electricity
- Supply the necessary power output (1 to 10 KW) according to consumer needs
- The ability to store energy for uncharged days (Consecutive Cloudy Days), and nights
- Ease of maintenance and operation



Marine Transformer Rectifier

The body of the ship is corroded when it comes to seawater, and its corrosion rate varies depending on their speed, the water temperature, the amount of salt present, and so on. Therefore, a smart transformer rectifier with automatic output adjustment is used to protect the body of the ship. Its negative output is connected to the body of the ship and the positive output is connected to the left and right body of the ship through two anodes.



Two reference electrodes are installed on the left and right sides of the ship to measure potential difference.

The two reference electrodes are connected to the transformer rectifier and due to their lower potential, a suitable current is induced to protect the ship's body.

Compact Transformer Rectifier

Compact Transformer Rectifier Components

- Transformer rectifier
- AC power supply
- Positive bond box
- Negative bond box

Benefits of Compact Transformer Rectifier Station

- Significantly reduces the price of land purchased
- Ability to install in public spaces (Sidewalks, Green Areas, etc.)
- Help with the beauty of urban furniture
- Remove wellhead installations and equipment
- Easy access to equipment and ease of repair
- Remove fence and door of cathodic protection station



Microprocesses Transformer Rectifier (Switching)

In intelligent cathodic protection systems, one or more permanent reference electrodes are used to control the current for feedback potential to the control unit.

Microprocesses Transformer Rectifier Components

- The microprocessor unit of this transformer rectifier consists of two parts:
 - Receiving unit for input samples (Permanent Reference Electrodes Potential)
 - Input processing unit
- Display output unit
- Analog output unit

Types of Smart Rectifier

- Smart single reference
- Smart multi reference



Remote Monitoring and Control (CPRM)

To ensure correct operation of cathodic protection systems, always it is necessary to periodically perform measurements of system parameters. Due to the geographic and climatic diversity of the country and oil, gas transmission pipelines and same field in mountainous, desert or forest area and inspection requirement, always has faced with certain difficulties and high costs.

Remote Monitoring

Monitoring system regardless of the type of device and its manufacturer and without any limitation can be installed on various transformer rectifier.

Some of measurable and monitoring parameters are as follow:

- Vac: Input voltage of transformer rectifier
- Iac: Input current of transformer rectifier
- Vdc: Output voltage of transformer rectifier
- Idc: Output current of transformer rectifier
- Vref: The potential of equipment under protection
- Oil Temp: Oil temperature
- Oil Level: Announce reduction of oil level

Control

Remote control on the devices which were equipped with a remote monitoring system are possible. The main parameters of transformer rectifier that are controllable are as follow:

- Remote switching system
- The ability to control and adjust the output current or output voltage of transformer rectifier
- The ability to control reference potential vs. designed half-cell and thus intelligent control of output voltage and current of transformer rectifier

Basic Benefits of Remote Monitoring and Control System

- Control, measurement and storing of transformer rectifier parameters and measured potential by reference electrodes and compare them with each other
- Automatic adjustment of current and voltage of transformer rectifier
- Preventing human error
- Saving time and cost for not having periodic visit
- The ability to interrupt multiple transformer rectifiers
- Ability to display the geographical location of the stations in the map by GPS/GPRS hardware



Software Capabilities

- Create a complete identity of cathodic protection stations
- Warning sign in case of a general defect
- Send possible system error by GSM network
- Collect and store information
- Sending information via computer and internet
- Warning sign in the case parameters changes compared to predetermined value
- Providing independent archive of information about each station and comparison of information
- Communicate and store information periodically and automatically (Without the Need for User)
- Ability to provide data in the form of software and display them in various shape like: file, chart, chart table and so on

Communication Methods of Monitoring and Control System

- Serial port (RS 232, Modbus, Shared bus)
- Modem and telephone line (Modem)
- Optical fiber
- Local area network (LAN/ TCP/ IP)
- Mobile (GSM Mobile/ GPRS)
- Satellite mobile
- Wireless Frequencies (RF Link)



2. All Types of Boxes

All of these boxes are suitable for installation in safe and hazardous areas which are as followings:

- AC Box (1 & 3 phases)
- Current Control Box (Variable Resistor Box): These boxes have variable resistors in two types of on-load and off-load applications which can be used for adjustment of required cathodic protection potential in protected structure.
- Lines & Groundbed Markers: Liners are installed for locating the buried pipelines.
- Control and Measurement Posts: These boxes are suitable for potential and diagnostics in inhabited areas.
- Anode Junction Box: IS used for terminating the anode cables and for connecting of them with main positive cable coming from the DC-source unit.
- Cathode Junction Box: IS used for terminating the cathode cables and for drainage of current to protected structure.

3. Impressed Current Anodes

Impressed current anodes are used in cathodic protection systems. These anodes are powered by the DC current from an external source. A proper selection of impressed current anodes would include the consideration of the environment that surrounds a buried or submerged structure to control corrosion.

3.1. Mixed Metal Oxide (MMO) Anode

After introducing and presenting new evolved structure of mixed metal oxide anodes, it has solved the previous problems of using old types of anodes such as high weight, fragility, short life time, etc.

Besides, instead it has been earned obvious distinctive capabilities such as low consumption rate, dimensional stability and current density. MMO anodes are suitable for use in soil, coke backfill, fresh water, saline water, sea water and concrete.

Types of MMO Anodes

- Tubular Anode
- Ribbon Anode
- Borflex Anode
- Rod Anode
- Mesh Anode
- Wire Anode

3.2. High Silicon Cast Iron Anode



silicon iron anodes are probably the most common anodes used in ground bed construction and the high corrosion resistance environment. Chromium iron alloys means that life time in excess of 20 years may be achieved.

Types of Silicon Anodes

- Rod Type
- Tubular Type



3.3. Platinized Anode

Platinized anodes are made from two parts of base metal and coating. Titanium, niobium and tantalum are used as a base metal and a very thin layer of platinum is applied on it. Base metal acts as anode and conductor body, platinum acts as an active component of the anode.

Types of Platinized Anodes

- Titanium platinized anode
- Niobium platinized anode
- Tantalum platinized anode



3.4. Lead/Silver Anode

Lead/Silver anodes are almost exclusively used in salt water environments. Lead / Silver anodes are suitable for docks that required anode suspension from rope, brackets or other mounting devices.



4. Galvanic Anodes

Galvanic anodes are used in any condition which permanent current feed won't be available, in protection of temporary projects and in small constructions and structures.



4.1. Magnesium Anode

Standard and high potential magnesium anodes are the most consumable sacrificial anodes for under ground pipelines and above ground tanks. Anodes are installed during the construction period and prior to energizing the permanent impressed current system.

Typical Applications

- Pipelines
- Heat exchangers
- Tank internals
- Tank external surfaces



4.2. Aluminum Anode

Aluminum anodes has an electrochemical property that makes them suitable for cathodic protection systems with driving voltage of 300mv against protected steel and rather three times the capacity of zinc anodes. These anodes are capable of achieving high output capacity in mud and brackish water.

Typical Applications

- Submarine pipelines
- Offshore structures
- Ship hulls
- Marine structures
- Sheet pile walls
- Tank internals



4.3. Zinc Anode

Zinc is considered a reliable material. Zinc has a relatively low driving voltage, which means in higher resistivity soils or water it may not be able to provide sufficient current. However, in some circumstances -where there is a risk of hydrogen embrittlement, for example - this lower voltage is advantageous; as overprotection avoided. Zinc anodes should not be used for above 50°C medium temperature, because the driving potential will be reduced when the temperature increased. This sacrificial anode is used in seawater and soils with low resistance. Zinc anodes are cast from high purity zinc.

Typical Applications

- Submarine pipelines
- Offshore structures
- Quay walls
- Marine structures
- Ballast tanks
- Tank internals
- Ship hulls



5. Measurement Instruments

5.1. Reference Electrodes

Purposes of these Electrodes are measurement of value of difference protective potential at efficiency determination of anti-corrosion protection of structures, provides of operation of cathodic protection rectifiers in automatic mode, measurement of polarized potential value of protected construction by portable devices.

Cu-CuSO₄ Half Cell (Permanent and Portable)

These electrodes are the accepted and standard for measurement of potential on land installation such as pipelines, tanks, etc.



Zinc Reference Electrode

High purity zinc electrodes can be used in saline water or on land installations when package with moisture retaining backfill.



Ag-AgCl Half Cell (Permanent and Portable)

Normally used for measuring potentials on seawater installations such as jetties, cooling water pipings, etc.



5.2. Multimeters

Multimeters are used to measure electrical parameters. Multimeters are produced in digital and analog type. The Multimeters used to measure cathodic protection systems must have a high input impedance (Mega-Ohm). It can measure:

- Phase to phase voltage for 3 phase systems
- Phase to null voltage
- DC voltage
- DC ampere



5.3. Data logger

To evaluate the cathodic protection systems and the corrosion process, need accurate information about potential value of the structure and this requires the use of appropriate measurement equipment.

One of this type of measurement equipment are data loggers, that are able to continuously record high speed electrical parameters (Cathodic Protection Potential) and has the ability to store these informations. Having this information would be of great help to evaluate the behavior of the cathodic protection system of the structure.

The operation of data loggers are similar to multi meters with this different that, they are able to continuously record measured data, and their sampling speed rate are higher than multi meters.



5.4. Synchronize Interrupter

One of the criteria for protective potential of cathodic protection systems is instant off potential.

In projects that structures set under the protection of several cathodic protection stations and consist of different transformer rectifiers, in order to measure instant off potential, it is necessary for all transformer rectifiers to be switched on and off simultaneously at a specified time. To do this it is necessary to use synchronized interrupter.

For the synchronization of cathodic protection stations, various methods are used such as the followings:

- Microwave
- Direct cabling
- Landline phone or mobile GSM
- Satellite watches (GPS)

The synchronize devices in the form of an independent sector can be installed in the cathodic protection station or can be used as a portable.

5.5. Insulation Kit Tester (RF Tester)

One of the tests recommended for the insulation kits, is radio frequency test. For the test of insulation kits that are used in flanges, the RF tester is used. The test is done by sending radio waves. The use of megger device for the insulation test, given that the circuit may be established through the earthing system, is not reliable.

5.6. Portable Power Supply (Test Station)

To facilitate temporary current supply for cathodic protection system, portable power supply is used. This device requires no power input and by the use of internal battery and inverter circuit, provides voltage and needed current requirements. The device is made and released to the market with 30V and 5A capacity, and has the ability to create different voltage and current in accordance with the customer order.



6. Accessory Equipments

6.1. Earthing System Equipments

High quality earth rods are usually made from either solid copper, stainless steel or copper bonded steel. Borna electronics can supply all three types in a variety of dimensions with their accessories such as clamps, driving stud, coupler, and spike. The copper bonded steel cored rod is the most popular, due to its combination of strength, corrosion resistance, and comparatively low cost. Solid copper and stainless steel rods provide a very high level of corrosion resistance at the expense of lower strength and higher cost.

Earthing set (Rod) comprising following accessories:

- Earthing rod in any size
- Earthing cable (Yellow/Green)
- Earthing bare copper wire
- Driving tip
- Driving cap
- Coupling equipment
- Clamp for connection of wire to rod

6.2. Zinc Earthing Cell

Creation of high potential difference between two parts of the flange is possible due to the induction or occurrence of flash over, which results destruction of flange insulation. This event happens in part of pipelines which is used for insulating two parts of pipeline by insulating kit. So, zinc anodes are used as earthing electrode in order to prevent these problems. The chemical composition of these electrodes is similar to buried zinc anodes in soil. Zinc earthing cells can be binary or quaternary. Also, their collections stay on like earthy zinc anodes in backfill (Usually Containing 75% Gypsum, 20% Bentonite and 5% Sodium Sulfate).



6.3. Spark Gap

Spark gap are installed on the flanges that have insulation kit. Since the gaskets of insulation kit, have electrical and physical resistance for the specified voltage, it is possible in the event of lightning or possible error, the gasket get damaged.

For this reason for gasket protection, spark gap is used.

Spark gap operation is in this way, when there is an error, it pass the current flow to its path and thus, there won't be any damage to insulation kit. The other use of spark gaps is to prevent sparks (Electric arc) on both edges of the flange, to prevent this from happening in risky environments is of great importance.

Spark gaps are made in two conventional type safe and explosion proof with different current ranges.



6.4. DC Decoupling Device

Cathodic protection current Leakage to foreign structures or grounding systems is one of the major issues which reduces the effectiveness of CP systems and energy loss. Polarization cell, solid state polarization cells (PCRs) or over voltage protection (OVP), as an DC decoupling device, usually are installed in series between the protected structure and other foreign structures e.g. grounding systems and their function is to prevent current loss (DC Current) to other structures and conduct high AC voltages, lightning, and AC fault currents to earthing or grounding systems.

DC decoupling devices are manufactured in two type, liquid or solid. Type of this equipment is selected based on the installation location, design parameters and maintenance requirements.

Application

- PC, PCRs or OVP main applications can be summarized as followings:
- Electrical isolation between grounding systems and cathodic protection systems
- Electrically isolated flanges
- Reduction of inducted impacts of AC current
- Isolation of two separate earthing system



Solid Type

- Solid state polarization cells can be used in hazardous and safe areas, depending on their enclosure type (Safe or EX Type).

Specification

Some of the important specifications of PCRs or OVP are:

- AC fault current rating
- DC voltage threshold
- Lightning impulse current rating class
- AC steady state current
- Enclosure type and specifications (Safe, Ex)

BORNA ELECTRONICS Production Optional Specification:

➤ AC Fault Current Rating

1 Cycle @ 50 Hz.	3 Cycle @ 50 Hz.	10 Cycle @ 50 Hz.	30 Cycle @ 50 Hz.
2.5, 5, 7.5 10 and 15 kA	2.5, 5, 7.5 10 and 15 kA	2.5, 5, 7.5 10 and 15 kA	2.5, 5, 7.5 10 and 15 kA

➤ DC Voltage Threshold

-15, -6, -4, -3, -2 / +1, +2 (V DC)

* DC voltage threshold can be specified by customer request.

➤ Lightning Impulse Current Rating Class

100 kA – 8/20 μs
750 kA – 8/20 μs

➤ AC Steady State Current

25, 30, 40, 50, 75 and 100 (A)

➤ Enclosure Type

Safe (IP 42, 54, 55, 65)
EX type

Liquid Type

Liquid polarization cell are comprised of a PVC box, nickel sheets dipped in KOH solution. It is possible to put several units depending on voltage and current requirement, in series or parallel circuits.

➤ DC Voltage Threshold

-1.5 to -2 (V DC)

➤ AC Fault Current Rating

5 KA
10 KA
15 KA



6.5. polarization Coupon

IR drop errors are a significant source of inaccuracy in potential measurements on underground structures. There are a number of sources of them including the structure's own cathodic protection current and stray currents from other sources. In theory, IR drop free potential measurements can be made by interrupting all current sources simultaneously and making an "instant off" potential measurement. In practice, this is very difficult so CP coupons are used instead. CP coupons simulate an uncoated part of the structure to which they are electrically bonded. Measurements are made by momentarily disconnecting the coupon and recording the "instant disconnect" potential. This reading approximates an IR-drop free potential on the structure at the location of the coupon. CP coupons provide the ability to measure an error-free "instant-off" pipe to soil potential, to prove the level of cathodic polarisation achieved on the pipeline. They are particularly useful in areas subject to stray currents and on all cathodic protection systems where the synchronised interruption of current supplies is complex or impractical. CP coupon is made from carbon steel with an exposed area of 25cm² and has an epoxy base to seal and protect the wire connections. Two 12 AWG stranded copper leads are provided for connection to a CP test station.



6.6. Insulation Kit

Flange insulating kits are used for electrically isolating cathodic protected pipeline section from unprotected pipelines or other metal structures. A flange insulating kit includes following parts:

- Central gasket
- Metal washers
- Insulating sleeves
- Nut & bolts
- Insulating washers



6.7. Cables

Cathodic Protection cables are with copper or aluminum conductors and have PVC, XLPE, PE, HMWPE and PVDF (Kaynar) insulation shield, depending on application system and chloride contents in environment.

Cable may be manufactured in single or double jackets and in armored or non-armored types. It could be manufactured in Low voltage power cable or Medium voltage power cables.



6.8. Splicing Kit

The kits are designed for both non-armored and armored low voltage cables.

The polyurethane resins in these kits guarantee a perfect sealing, an electrical insulation and a mechanical protection. Each kit comprised of resin, moulds, sealing tape and an instruction sheet.



6.9. Wellhead Equipment

In the well foundation of cathode protection system (Water Well), wellhead equipment is used to install and maintain anodes inside the well. This equipment is also used to remove anodes during repairs. The wellhead equipment consists of two steel bars with a holder, an aluminum pulley, a wooden pulley and a handle.



6.10. Anode Centralizer

The anode centralizer is used to stabilize the position of the anodes installed inside the well. The anode centralizer should be made of insulating material. Typically they are polyethylene.



7. Exothermic Welding System

Exothermic welding, is a welding process that employs molten metal to permanently join the conductors. The process employs an exothermic reaction of a thermit composition to heat the metal, and requires no external source of heat or current.

The Borna Electronics exothermic welding system:

- Is completely portable
- Makes excellent corrosion resistance and highly conductive connections
- Can be used for over 50 standard connection configurations
- Is cost effective
- Requires no external power or heat source
- Creates high quality electrical connections

Graphite mould for all types of connections

Exothermic cartridge in all sizes

Accessories for welding system (Handle Clamp, Flint Gun, Scraper Tools)



8. Pin Brazing

The connecting method of pin brazing device is by creating an electric arc between the pin and corresponding structure silver alloy surfaced melted pin and cable connection. To connect pin and structure, there is a need for an short time electric arc with low temperature. Given that pins are silver plated, the connections will have low electrical resistance.

The advantages of pin brazing over welding are low probability of error, creates less heat than common thermit welding connection, the possibility of doing it in the rain, high speed of user connection and user friendly equipment.

Pin brazing device include a section for generating of an electric arc, corresponding batteries and special gun. For each welding there is a need for a cable lug, pin and ferrule suitable with the connecting cable, and specially made for pin brazing device.



9. Coatings

9.1. Handy Cap

Is a prefabricated assembly designed for cathodic protection of leads to pipes. when handy cap pressed by hand in to position over the lead wire weld, it forms a thick, highly resistant electrical insulation seal over the weld, the end of the lead wire and the surrounding area of the pipe.

9.2. Insulation Wrap

Insulation cold wrapping tape applied for coating system for corrosion protection of oil, gas, petrochemical and water underground or overhead pipes.

9.3. Primer

Primer is quick drying, solvent based, high- tack primer specifically designed to promote maximum adhesion. It used for all surfaces prior to the application of various tapes.

10. Carbonaceous Backfill for Impressed Current Anodes

Conductive, metallurgical and petroleum coke breeze backfill should be used to lower the total resistance of the groundbed, to improve current distribution in anode environment.

Based on environment condition and cathodic protection system carbon content selection is changed by designer.

Carbonaceous backfill material, as will be specified by the purchaser, shall be one of the following:

- | | |
|--|-------------------------|
| • Type 1: coal coke breeze | carbon content min. 80% |
| • Type 2: calcined petroleum coke breeze | carbon content min. 90% |
| • Type 3: special calcined petroleum coke breeze | carbon content min. 95% |

11. Backfill for Sacrificial Anode Packages

Backfill for sacrificial anode packages usually containing:

- Gypsum 75%
- Bentonite 20%
- Sodium Sulphate 5%



Reference List

In more than 30 years activity in cathodic protection field, BORNA Electronics Co. has offered these duties to industry:

- Manufacturing and selling of more than 5000 cathodic protection transformer rectifiers
- Manufacturing of more than 2000 tons marine aluminum anodes specified for offshore jackets
- About 1500 tons of magnesium and zinc sacrificial anodes
- More than 15000 different types of impressed current (Silicon-MMO) anodes
- More than 1000 different types of reference electrodes

BORNA Electronics Co. has accomplished great national projects mostly according to appendix:

Year	Responsibility*	Project Title	Client/End User
2003	EPC	Amak Project Khuzestan	PEDEC
2005	PC	Namroud-Rey Petroleum Pipeline	NIOEC
2006	PC	On Site, Off Site & Sewage Pipeline in Mahshahr Economic Zone	Fajr Petrochemical Company
2007	E	Oil Storage Tank in Zahedan, Zabol and Khash	NIOFDC
2007	PC	Oil Storage Tank in Kerman	NIOFDC
2007	EPC	Tehran Refinery Piping	Tehran Oil Refining Co.
2007	EPC	Development of Shazand Arak Refinery	NIOEC
2008	EPC	Phases 15 & 16 Asalouyeh	POGC
2010	EPS	Shahid Shoushtari Oil Storage Tanks	NIOFDC
2010	EPC	Kermanshah Petrochemical Piping	Kermanshah Petrochemical Co.
2011	EPC	Condensate Storage Tanks External Phases 22, 23 & 24 Kangan	POGC
2011	EPC	Condensate Storage Tanks External phases 13 Kangan	POGC
2011	EPC	Condensate Storage Tanks Internal Phases 19 Kangan	POGC
2012	EPC	Phases 20 & 21 Asalouyeh	POGC
2014	EPC	Pardis Petrochemical Piping Phase 3	Pardis Petrochemical Company
2015	O & M	Phases 15 & 16 Asalouyeh	POGC
2015	EPC	Flare Piles of Phases 22, 23 & 24 Kangan	POGC
2015	EPS	Regional Water Company of Boushehr	Nour Vijeh Co. (NVCO)
2016	EPS	Shirvan Combined Cycle Power Plant	MAPNA
2017	EPS	Water Transmission Pipeline from Persian Gulf to Southeastern Iranian Industries	WAS CO
2017	EPS	Azar Oil Field Development	Sarvak Azar Engineering and Development (SAED)
2017	EPS	Sabalan Combined Cycle Power Plant	MAPNA
2018	EPC	Abadan Refinery	MSA Engineering & Construction Co.
2018	EPS	TABAN (Yazd) Combined Cycle Power Plant	MAPNA
2018	EPS	Miandoab Petrochemical Piping	Bakhtar Petrochemical Company
2018	EP	Lavan Petrochemical Piping	Lavan Industry Development Company
2019	EPS	NGL 3100	NIOEC
2019	EPS	Parsian Gas Refinery	Palayesh Parsian Sepehr Co.

* E: Engineering, P: Procurement, C: Construction, S: Supervision, O: Operation, M: Maintenance

History

BORNA Electronics Co. has begun production of electrical industrial equipments at 1984 and at 1989 has taken action to produce cathodic protection equipments with attention to variable useful standard such as NACE, BS, DNV, IEC, ASTM, IPS, etc.

Now BORNA Electronics Co. stands out as a manufacturer for cathodic protection equipments with high quality and efficiently for various industries such as Oil, Gas, Petrochemical and Marine, etc.

This company by utilization of quality management system has certification IMS and HSE management system, ISO 9001:2015, OHSAS 18001:2007, ISO 14001:2004, from Germany DQS company about design and production.

According to field of activities, BORNA Electronics Co. has signed four cooperation agreements, with Corpro a UK, Gescor a Italy and Korupp a Germany based company for design and consulting of cathodic protection projects; with FF Automation a Finland based company for remote monitoring and control.

Our international partners have announced that will be ready for performance of EPC projects especially in cathodic protection systems.

